



LYNDON B. JOHNSON SPACE CENTER

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2014: A New Era Launched

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On the cover:

In this edition, we look back on 2014's program and center milestones and accomplishments. Thanks to your efforts, JSC is leaner, more agile and more adaptive to change.

2014 ENDED IN THE BEST WAY POSSIBLE, with a super EFT-1 mission.

In fact, I'm writing this column as the Orion crew module is bobbing in the Pacific Ocean, awaiting the recovery forces. It was so exciting to be in with the Mission Management Team, along with the administrator and other agency senior leaders, to share in the energy, enthusiasm and sheer joy of Orion's flight -- this is what we are all about! And this issue of the Roundup highlights many other achievements and activities that our JSC team worked together to make happen throughout 2014, including ISS research and development (along with the crew and cargo missions that enable that), commercial crew certification contract awards, technology development milestones, and the new knowledge coming from Mars robotic exploration that is laying the groundwork for future human missions.

With that in mind, I am already looking forward to 2015, which promises to bring visible progress toward developing and demonstrating the capabilities we need to pioneer space and eventually get humans to Mars:

- We will launch two people on a one-year mission on ISS, putting a spotlight on gaining knowledge about human health and performance for exploration missions;
- We will be welding the crew module pressure vessel for Orion's next flight Exploration Mission-1 (EM-1);
- And deciding what Asteroid Retrieval Mission (ARM) option to pursue and what exploration missions we need to plan to lead up to carrying out the crew portion of ARM;
- We will attach an inflatable module from Bigelow Aerospace to the ISS using technology licensed from JSC, and compare many aspects of inflatables to aluminum modules, including measuring the radiation environment through our JSC radiation technology development project;
- We will be implementing MCC21 into our ISS control room, moving us away from expensive custom hardware and software and saving ISS around \$60 million a year going forward in operations costs;
- Through a series of EVAs and robotic operations, we will configure ISS, by end of year, to be able to have a variety of vehicles docked, including commercial crew vehicles, and also make progress on docking for exploration vehicles;
- We will complete the parachute drop tests by the end of 2015, supporting the final configuration of parachutes that we, JSC Engineering, deliver to Lockheed for Orion;
- And near the end of the year, we'll showcase what we are accomplishing on ISS as we celebrate 15 years of continuous habitation, and support a new conference in Houston, SpaceCom, that focuses on exploring the business of space;

Our JSC 2.0 efforts will continue to be key in making these and future events happen in a more efficient and effective way so that we can continue to advance human spaceflight, and have more days like today!



NASA/PHOTO

Ellen Ochoa

Director, Johnson Space Center

Ellen Ochoa

The Top 10 International Space Station medical advancements to watch

FOR MORE THAN 15 YEARS, researchers have gleaned important results that improve our understanding of basic biological and physiological processes unmasked in the microgravity environment. Medical advancements based on these results are often necessary to protect astronaut health, but these also lead to Earth applications in areas such as telemedicine, disease models, psychological stress response systems, nutrition and cell behavior.

While these findings are improving human health and medical technology in space and on Earth, there are more results to watch for as research continues aboard the International Space Station. As another year comes to an end, this list of the top 10 medical advancements to watch from previous investigations in microgravity is worth our reflection. In no particular order of importance, they are:

10. Cool plasma for wound healing

Using the microgravity environment, physicists studied how crystals form inside dusty plasmas—a type of matter with distinctive properties found everywhere. Due to its gaseous state, plasma can quickly disinfect surfaces or neutralize drug-resistant bacteria. Clinical trials have shown that cold atmospheric plasma is helpful in disinfecting wounds, expediting wound healing and aiding in cancer therapy.

9. The study of model organisms and the potential for discoveries

Model organisms are non-human species with characteristics that allow them easily to be reproduced and studied in a laboratory. Scientists are currently studying the effects of spaceflight on fruit flies to understand potential long-term risks to cardiovascular health. Previous studies of mice in orbit led to the availability of a pharmaceutical on Earth to treat people

with osteoporosis. Another investigation that examined the progression of increased tumor formation associated in fruit flies showed that spaceflight alters their immune response, similar to immune suppression observed in astronauts. These types of studies can help scientists develop countermeasures to keep astronauts healthy over long-duration space missions, which can then translate to disease prevention efforts on Earth.

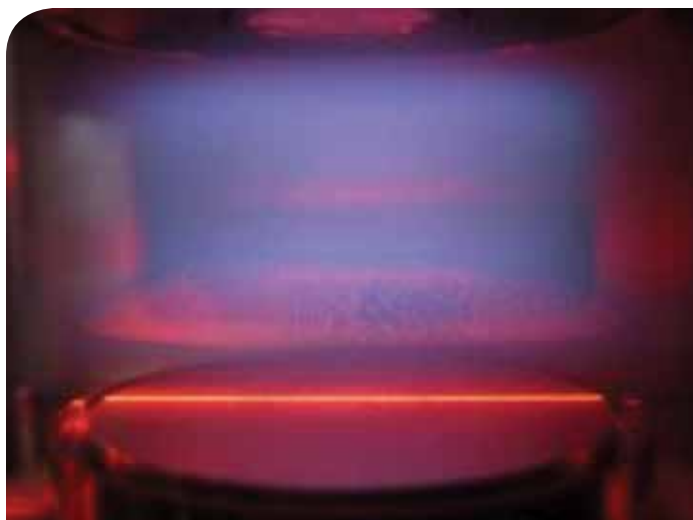
8. Immunology changes in microgravity

NASA and the National Institute on Aging have partnered in support of microgravity research to one day advance medical care and improve quality of life for older adults. Scientists are using the unique space environment to investigate the molecular mechanisms of immune suppression commonly seen in older adults. While it usually takes genetic and molecular changes associated with aging-related immune suppression decades to occur, changes in the immune system happen more rapidly in space. The goal is to develop better protective measures to prevent disease in crew members and find new treatments for a range of auto-immune diseases such as arthritis and diabetes.

7. The prevention of the loss of bone mass in space through diet and exercise

In the early days of the space station, astronauts were losing about 1.5 percent of their total bone mass density per month. Researchers discovered that high-intensity resistive exercise, dietary supplementation for vitamin D and specific caloric intake can remedy this problem. This research is important for long-duration spaceflight, educating children and for treating frail, older adults.

PHOTO: MAX PLANCK/ INSTITUTE FOR EXTRATERRESTRIAL PHYSICS



Side view of a plasma crystal in the laboratory. Dust particles are suspended in an argon plasma above a high-frequency electrode (bottom). The horizontal field of view is 2 cm.



Fruit flies such as these spent one month aboard the International Space Station during the Heart Flies study.

NASA PHOTO/ DOMINIC HART

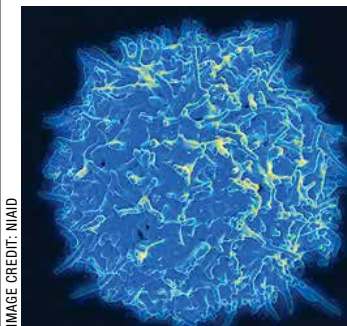


IMAGE CREDIT: NIAID

Scanning electron micrograph of a human T lymphocyte (also called a T cell) from the immune system of a healthy donor.

body—such as the herpes virus which causes shingles and chicken pox. Stress associated with spaceflight can result in decreased immunity that reactivates latent virus, allowing the virus to shed, or be passed to others. Based on the NASA study of latent virus, technology was developed that can detect immune changes early enough to begin treatment for shingles before lesions appear, and also assist in detecting latent virus in astronauts before they pass it to other crew members during long-duration spaceflight.

4. The -omics approach analysis of immune cells

The term “-omics” refers to a broad area of biological and molecular studies that, in general, mean the study of the entire complement of biomolecules. This includes proteins (proteomics); metabolites, the

6. The study of capillary flow and lab-on-a-chip technology application

Capillary Flow Experiments (CFE) aboard the space station study the movement of a liquid along surfaces, similar to the way fluid wicks along a paper towel. These investigations produce space-based models that describe fluid behavior in microgravity, which has led to a new medical testing device on Earth. This new device could improve diagnosis of HIV/AIDS in remote areas, thanks in part to knowledge gained from the CFE.

5. Latent virus shedding

Latent virus is an inactive virus that lies dormant within the

end products of metabolism (metabolomics); or genes (genomics). One new —omics study in microgravity looked at cell and tissue cultures to examine wound healing in space. The molecular information obtained is potentially beneficial to human health research.

3. Protein crystal growth

Japanese scientists crystallized a human protein-inhibitor complex (H-PGDS/HQL-79 complex) on the space station. An inhibitor complex helps to decrease genetic activity that may cause illness or disease. Using microgravity, researchers were able to grow larger, high-quality crystals, which allowed them to more accurately determine 3-D structures of a protein complex. These findings led to the development of a more potent form of the protein-inhibitor. Since the H-PGDS protein adds to the formation of Duchenne muscular dystrophy, this research is important to the development of a new treatment for this inherited disorder.

2. Hepatitis C research

The first Egyptian protein crystal growth study recently conducted aboard the space station observed proteins that make up the hepatitis C virus. Hepatitis C is a contagious liver disease highly prevalent in Egypt that can be mild, lasting weeks, or serious and become a long-term illness. The study goal is to understand how the virus replicates to develop new methods for treatment of viral infections like hepatitis C.

1. Breast cancer treatment and detection technology

A surgical instrument inspired by the Canadian Space Agency's heavy-lifting and maneuvering robotic arms on the space station is now in clinical trials for use in patients with breast cancer. The Image-Guided Autonomous Robot (IGAR) works inside an MRI to help accurately identify the size and location of a tumor. Using IGAR, surgeons also will be able to perform highly dexterous, precise movements during biopsies. Another space station investigation to study breast cancer cells, CYTOSPACE, begins in 2015.



NASA PHOTO

Capillary Flow Experiments aboard the space station are used to study the movement of a liquid along surfaces. A new medical-testing device has been developed that could improve diagnosis of HIV/AIDS in remote areas, thanks in part to knowledge gained from the CFE.

Commercial Crew Program continued to make progress in 2014

STEADY AND SIGNIFICANT PROGRESS within the Commercial Crew Program throughout 2014 means the development and testing schedule of spacecraft that will carry astronauts and cosmonauts to and from the International Space Station is on track.



NASA/PHOTO KIM SHIPLETT

An Erickson Sky Crane helicopter returns the SpaceX Dragon test article to Morro Bay, Calif., following a test to evaluate the spacecraft's parachute deployment system.

The award in September of contracts supporting the Commercial Crew Transportation Capability (CCTCap) is a major milestone that moves spacecraft and launch vehicles into the next phase of certification. The Boeing Co. and Space Exploration Technologies Corp. (SpaceX) were selected to develop, test, certify and fly new human-rated spacecraft from American launch sites once again.

Fostering a government-partner relationship, the Commercial Crew Program saw many milestones completed as it transitioned from proving the integrated concepts of spacecraft and launch vehicles, to fully certifying them for flight.

Even as that transition occurs, NASA's Commercial Crew Program continues its partnerships with two other companies through Space Act Agreements: Blue Origin and Sierra Nevada Corp.

The real potential of this program focuses on the partnerships today that have great future potential to support commercial customers as well as NASA. Last year was pivotal in proving the program could hold its ground and grow stronger with a confident government/contractor team that works closely together.

The new way of doing business now is heading into its fifth year as milestones are completed and vehicle design and testing matures. One of the unique aspects to the Commercial Crew Program is that while the program office is based at the Kennedy Space Center, half of the workforce is at Johnson Space Center, with an integrated team comprised of engineers across several directorates. Another area of consistency is the belief in the Commercial Crew Program effort across NASA and the partnership. It is successfully tapping into engineering expertise in all aspects of human spaceflight that exists across the agency.

Contracting with commercial companies holds great promise to NASA for reliable crew transport that will return human spaceflight missions to and from the space station to the United States. Human spaceflight did not begin commercially—yet every human-rated spacecraft has been built by private industry. NASA provided the requirements for safety certification and now is providing the foundation for a business model that hopefully will allow a commercial human spaceflight industry to flourish.

A new car design typically takes five years from development to showroom. A new spacecraft to ferry astronauts and cosmonauts to and from the space station is less than three years away.

The NASA and contractor team is in place to transition from design to reality using experience and lessons learned from past programs as the foundation on which a safe commercial human spaceflight industry will rise.

The Commercial Crew Program is overseeing the development of new human-rated spacecraft that will maintain the robustness of the space station to expand our reach further into space while improving lives on Earth through short- and long-term research.

For more information about NASA's Commercial Crew Program and CCTCap, visit: <http://www.nasa.gov/commercialcrew>



IMAGE CREDIT: BOEING

Artist concept of the Boeing CST-100 spacecraft on launch pad.

Milestones 2014

NASA/PHOTO ISS038-E-054979



FEB. 22:

Expedition 38 crew members pose for a crew portrait in the Kibo laboratory of the International Space Station. Pictured (clockwise from top center) are Russian cosmonaut Oleg Kotov, commander; Japan Aerospace Exploration Agency (JAXA) astronaut Koichi Wakata, Russian cosmonaut Sergey Ryazanskiy, NASA astronauts Rick Mastracchio and Mike Hopkins, and Russian cosmonaut Mikhail Tyurin, all flight engineers.

NASA/PHOTO 201405290008H0



MAY 29:

The Soyuz TMA-13M rocket is launched with Expedition 40 Soyuz Commander Maxim Suraev of the Russian Federal Space Agency, Flight Engineer Alexander Gerst of the European Space Agency and Flight Engineer Reid Wiseman of NASA at the Baikonur Cosmodrome in Kazakhstan.

NASA/PHOTO ISS038-E-013501



APRIL 20:

The arrival and ultimate capture and berthing of the SpaceX Dragon at the station, as photographed by Expedition 39 crew members onboard the orbital outpost.

NASA/PHOTO ISS040-E-015627



JUNE 19:

Russian cosmonauts Alexander Skvortsov (right) and Oleg Artemyev, both Expedition 40 flight engineers, participate in a spacewalk to complete installation and experiment tasks outside the Russian segment.

NASA/PHOTO



JULY:

European Space Agency astronaut and NASA Extreme Environment Mission Operations (NEEMO) 18 crew member Thomas Pesquet completes dive training during NEEMO 18.

JANUARY

FEBRUARY

MARCH

APRIL

MAY

JUNE

JAN. 9:

The trail of an Orbital Sciences Corporation Antares rocket is seen in this two-minute exposure as it launches from Pad-0A at NASA's Wallops Flight Facility. Antares is carrying the Cygnus spacecraft on a cargo resupply mission to the International Space Station. The Orbital-1 mission is Orbital Sciences' first contracted cargo delivery flight to the space station for NASA.

NASA/PHOTO 2014010900009H0



NASA/PHOTO ISS038-E-045009



FEB. 11:

The Small Satellite Orbital Deployer, in the grasp of the Kibo laboratory robotic arm, is photographed as it deploys a set of NanoRacks CubeSats. The CubeSats program contains a variety of experiments such as Earth observations and advanced electronics testing.

NASA/PHOTO ISS039-E-003124



MARCH 14:

Expedition 39 Commander Koichi Wakata of JAXA clowns with Robonaut 2, a humanoid robot, in the U.S. lab Destiny while preparing for a public TV event.

NASA/PHOTO ISS040-E-009124



JUNE 10:

In the station's Harmony node, Expedition 40 Commander Steve Swanson, NASA, harvests a crop of red romaine lettuce plants that were grown from seed inside the station's Veggie facility—a low-cost plant growth chamber that uses a flat-panel light bank for plant growth and crew observation.

NASA/PHOTO



EXPEDITION 39

NASA/PHOTO



EXPEDITION 40

NASA/PHOTO



EXPEDITION 41

NASA/PHOTO



EXPEDITION 42



AUG. 17:
Unoccupied Russian Orlan spacesuits for Russian cosmonauts Oleg Artemyev (blue stripes) and Alexander Skvortsov (red stripes), both Expedition 40 flight engineers, are pictured in the Pirs Docking Compartment of the station on the eve of the spacewalk.

NASA/PHOTO



SEPTEMBER:
At the United Launch Alliance (ULA) Horizontal Integration Facility at Cape Canaveral Air Force Station in Florida, the three primary core elements of the ULA Delta IV Heavy rocket were integrated, forming the first stage of the launch vehicle that will send Orion far from Earth.

NASA/PHOTO



OCT. 7
European Space Agency astronaut Alexander Gerst, Expedition 41 flight engineer, takes a "selfie" during the six-hour, 13-minute spacewalk to relocate a failed cooling pump to external stowage and install gear that provides backup power to external robotics equipment.

NASA/PHOTO



NOV. 10:
Expedition 41 Flight Engineer Alexander Gerst of the European Space Agency, left, Commander Max Suraev of the Russian Federal Space Agency, center, and NASA Flight Engineer Reid Wiseman sit in chairs outside the Soyuz TMA-13M capsule just minutes after they landed in a remote area near the town of Arkalyk, Kazakhstan.

JULY

AUGUST

SEPTEMBER

OCTOBER

NOVEMBER

DECEMBER

JULY 2:
Expedition 40 Flight Engineer Reid Wiseman of NASA works with a combustion experiment, the Burning and Suppression of Solids, in the Microgravity Science Glovebox in the Destiny laboratory of the station. The experiment seeks to provide insight on how flames burn in space compared to Earth, which may provide fire safety benefits aboard future spacecraft.



AUGUST:
Inside the Operations and Checkout Building high bay at NASA's Kennedy Space Center, technicians dressed in clean-room suits have installed a back shell tile panel onto the Orion crew module and are checking the fit next to the middle back shell tile panel in preparation for Exploration Flight Test-1.

NASA/PHOTO



OCT. 1:
The ULA Delta IV Heavy rocket for Exploration Flight Test-1 is lifted to the vertical position at the pad at Space Launch Complex 37 at Cape Canaveral Air Force Station in Florida.

NASA/PHOTO



DEC 5:
NASA marked a major milestone on its journey to Mars as the Orion spacecraft completed its first voyage to space. Orion blazed into the morning sky at 6:05 a.m. CST Dec. 5, lifting off from Space Launch Complex 37 at Cape Canaveral Air Force Station in Florida atop a United Launch Alliance Delta IV Heavy rocket. The Orion crew module splashed down approximately 4.5 hours later in the Pacific Ocean, off the coast of Baja California.



NOV. 11:
Orion has left the building! At Kennedy Space Center, the Orion spacecraft passes the spaceport's iconic Vehicle Assembly Building as it is transported to Launch Complex 37 at Cape Canaveral Air Force Station.

NASA/PHOTO



Mission complete: Orion makes history

SHOWERED WITH THE FLASHING of light bulbs capturing history in action, Orion successfully launched into space for its first mission, Exploration Flight Test-1, on Dec. 5 at 6:05 a.m. CST. NASA team members and millions of people across the world watched from Cape Canaveral, their local museum, on TV and their mobile devices as NASA pioneered the next generation of space exploration atop a United Launch Alliance Delta IV Heavy rocket.

Pushing the bounds of discovery, the flight tested the most advanced technologies, avionics, products and materials aboard the spacecraft. Traveling 3,600 miles above the Earth, Orion obtained critical information that will ensure the spacecraft's systems are ready for the challenges of future deep-space missions.

After its two-orbit mission, Orion headed back to Earth for its fast and furious landing at nearly 20,000 mph. The heat shield, the largest of its kind, proved successful after withstanding temperatures near 4,000 degrees Fahrenheit, while making its descent back into Earth's atmosphere.

"We really pushed Orion as much as we could to give us real data that we can use to improve Orion's design going forward," said Mark Geyer, Orion Program manager. "In the coming weeks and months we'll be taking a look at that invaluable information and applying lessons learned to the next Orion spacecraft already in production for the first mission atop the Space Launch System rocket."

Just minutes before splashing down into the Pacific Ocean, Orion's three main parachutes deployed as planned, slowing Orion for a smooth descent. Once the vehicle hit the water, the U.S. Navy efficiently recovered Orion and reeled it into the well deck of the USS Anchorage.

Mission complete!

So what's next? Orion will use the data captured from this flight to refine the vehicle and prepare it for its next test mission flight, Exploration Mission-1. For that mission, Orion will launch into space using the Space Launch System (SLS). More powerful than any rocket ever built, SLS will allow Orion to send humans to deep-space destinations such as an asteroid and eventually Mars.

Congratulations, Orion, and the entire NASA team! Well done.



NASA PHOTO

"Although this was an unmanned mission, we were all on board Orion."

— Mike Sarafin

Portable Life Support System 2.0 human-in-the-loop testing—a first of its kind in more than 30 years

ON OCT. 15, the Advanced Exploration Systems Advanced Space Suit Project began testing of the Portable Life Support System (PLSS) 2.0 with a person in the Mark III prototype suit. The human-in-the-loop integrated suit/PLSS testing is the first of its kind in more than 30 years, and will evaluate both the PLSS 2.0 test article and multiple liquid cooling and ventilation garments for thermal control and performance parameters, as well as the performance of the PLSS oxygen and ventilation subsystems. To date, more than half of the 22 tests have been done.

By placing a human in the loop for the testing of the PLSS 2.0, NASA reached a significant milestone in the development of a new suit, supporting both the possibility of a future exploration suit and an upcoming Developmental Test Objective on the International Space Station. Both the suit and PLSS have undergone stand-alone testing in the past, but this is the first time the systems have been integrated so that the advanced PLSS can be evaluated with a human inside.

"We are very excited to be trying out this hardware in this integrated suit/PLSS test that could someday help our astronauts explore Mars," said Liana Rodriggs, Advanced Space Suit Project manager.

"The preliminary results from the first tests look good," said Suit

Engineer Mallory Jennings.

The data presented is in line with the hypotheses the engineers and scientists had going into the test series.

Remaining tests will be finished in the coming weeks, which will see additional hardware integrated into the testing, such as new redundant loop liquid cooling and ventilation garment. It will be many months down the road before the final results from the tests are complete.

Human-in-the-loop testing is a "great example of what NASA is, and what we do," Jennings said. "Two teams, on different paths of development, come together to work together on an integrated system for testing."



NASA PHOTO ROBERT MARKOWITZ

On Nov. 5, human in the loop integrated testing for the PLSS 2.0 moves forward with test subject Lindsay Aitchison suited up in the Mark III prototype.

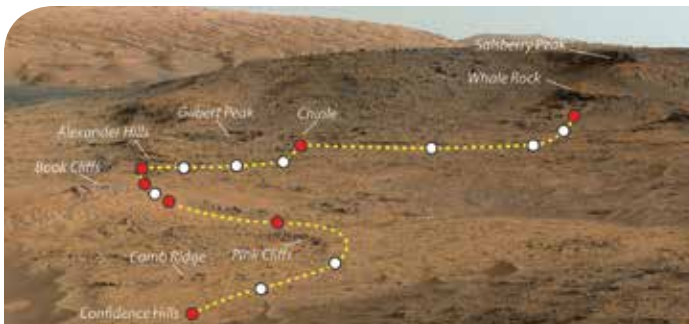
Projects and programs highlights

Mars Science Laboratory (MSL) mission powers forward

Johnson Space Center is still hard at work supporting Curiosity's ever-popular robotic mission on Mars. The Astromaterials Research and Exploration Science (ARES) scientists actively supporting MSL include:

- Doug Ming: Science Operations Working Group chair, who set the mission record for consecutive Sols (seven) in the operations lead hot seat
- Dick Morris: Chemistry and Mineralogy (CheMin) payload downlink lead
- Liz Rampe: CheMin payload uplink and downlink lead
- Doug Archer: Geology/Mineralogy science theme group Keeper of the Plan, Sample Analysis at Mars (SAM) payload downlink lead
- Paul Niles: SAM payload downlink lead

NASA recently announced the discovery of the mineral hematite in the drill sample materials from the Pahrump Hills outcrop interrogated by the CheMin and SAM instrument. ARES scientists were instrumental in characterizing the mineralogy and chemistry of this first drill sample in Mt. Sharp basement materials. Read more about it: <http://go.usa.gov/6Czk>



NASA PHOTO

This image shows the route that Curiosity took up the Pahrump Hills on the first "walkabout" of the outcrops.

Meter-Class Autonomous Telescope (MCAT) delivered

NASA's Orbital Debris Program Office, based at JSC, accepted delivery of the MCAT, a 1.3-meter aperture telescope that will be deployed on Ascension Island in 2015. MCAT will characterize the orbital debris population in under-sampled orbits such as low altitude, low inclination and near geosynchronous altitudes.



NASA PHOTO

Orbital Debris Program Office Scientist Dr. Sue Lederer and telescope designer Dr. Frank Melsheimer with the MCAT during factory testing.

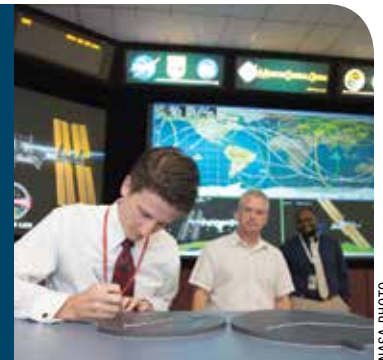
Biomedical team's ongoing contributions vital for spaceflight

One of the most honored rituals in mission control is the mission plaque-hanging ceremony. In each main flight control room at Johnson Space Center, plaques representative of each mission hang on the walls. At the end of each mission, the lead flight director selects a flight controller or team for their outstanding support for the honor of hanging the mission plaque on the wall.

In November, Wyle employee Russell Derrick, Expedition 40 Biomedical Engineer (BME) manager, was chosen to hold the ladder for the Increment 40 plaque-hanging ceremony. The BME team was recognized by Expedition 40 lead Flight Director Greg Whitney for their outstanding work preparing for and executing the numerous medical requirements during the increment, which greatly contributed to making the mission a success. In recognition of this effort, the team was selected to hold the ladder for the plaque-hanging effort following the flight.

The BME team helps ensure mission success by contributing to the development and continuous support of Crew Health Care System hardware and attaining the highest level of crew health and safety possible through comprehensive requirements definition, thorough planning, innovative training, procedure development, plan execution, data management, vigilant flight control support and a commitment to constant process improvement.

Expedition 40 BME Manager Russell Derrick signs the back of the plaque in mission control.



NASA PHOTO

Technology Transfer Partnerships Flourish

JSC's Technology Transfer Office focused on highlighting distinct technologies with the potential for commercial applications, assisting companies through the process of partnering with NASA, this past year.

Two companies, Technology Applications International Corp. (TAIC) and GRoK Technology, developed alternate uses for NASA's patented Rotating Wall Vessel (RWV) bioreactor. In addition, LifeNet Systems has a product based on technology developed by JSC inventor, James Locke, M.D., and William Schneider, Zachry Professor of Engineering Practice at Texas A&M College of Engineering.

TAIC's newest cosmetic cream, Rejuvel, uses supernatant (cell culture fluid) from human epidermal fibroblasts to minimize the effects of skin aging. GRoK intends to use the technology to produce proteins and biomolecules that can be used by researchers and physicians in treating disease.

LifeNet Systems hopes to create netted roadway barriers, that are taller and softer, to replace concrete and steel barriers. LifeNet Systems barriers have the potential to stop a vehicle traveling 80 mph safely.

2014 Social Media Highlights: The digital age is here

THE WORLD IS QUICKLY TRANSFORMING INTO THE DIGITAL AGE, and as more organizations begin to use social media—hashtags are everywhere, people are more mobile with tablets and smartphones and everything is moving online (if it hasn't already). When it comes to social media, NASA has always been ahead of the curve, and 2014 was no exception.

This past year was a notable year for Johnson Space Center on social media. The first Instagram image from space was posted, the first Vine video from space was posted, the International Space Station Facebook page surpassed 1 million fans, astronaut Reid Wiseman became a social media sensation during his six-month stay aboard the International Space Station and the world followed the journey of Orion from assembly to launch pad through videos, images and posts.



Astronaut Steve Swanson sent the first Instagram image from space on April 7. The @iss Instagram account grew by 60,000 followers in one day following this post and was recognized by major news outlets. The account, which started in January 2014, now has more than 230,000 followers to date and is used to share out-of-this-world images and videos from the space station with Instagram users around the world.

The agency has more than 480 social media accounts (and counting!) representing centers, programs, projects and people across the agency. This huge online presence is across 11 platforms: Twitter, Facebook, Instagram, Vine, Google+, SlideShare, Foursquare, Pinterest, YouTube, Flickr and SoundCloud, giving NASA the opportunity to share the wonders of space far and wide and in many different ways.

Wiseman began posting to his Twitter account (@astro_reid) while training for his mission to the International Space Station. When he launched to the station on May 29 and began tweeting from space, it didn't take long for him to receive widespread recognition for giving the world a glimpse of his perspective—a perspective only a handful of people get to experience firsthand. Not only did he do this by posting incredible images and captions on Twitter, but Wiseman also posted about 60 Vine videos throughout his mission. Vine is a social-media platform for sharing six-second looping videos. Wiseman sent the first Vine from space on June 6 and continued to post videos of lightning storms, sunrises and space station research experiments, which earned

him more than 50 million loops across all the videos. News outlets reported on Wiseman's posts over and over again and used his images and videos to report on weather updates and daily happenings.

After Wiseman landed back on Earth, BuzzFeed posted a story that reported, "Astronaut Reid Wiseman is totally winning at Twitter. Welcome back to Earth, Reid! Today is Astronaut Reid Wiseman's first day on Earth after spending 166 days in orbit aboard the International Space Station. Along the way, Wiseman has tweeted some of the most breathtaking and inspiring photos from outer space. Awe-inspiring pictures that change the way we think of our planet ... and astonishing photos that put city life into perspective."

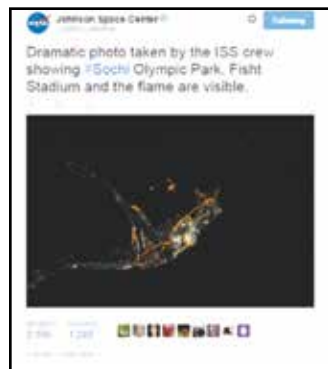
Why does NASA use social media? Wiseman explained it perfectly when he said, "Why do I use social media? Easy. Because living and working in low-Earth orbit is so visually amazing that it absolutely must be shared. Social media allows our crew to reach out to the world and bring them along for the ride. Spaceflight is the ultimate journey for our civilization, and we hope to rekindle the imaginations of the next generation of explorers and set them running free."

JSC uses social media to stay relevant and draw attention from new audiences. One way to do this is to take events that are heavily discussed on social and put a "space spin" on them. During the Olympics in Russia, the astronauts aboard the station took photos of Sochi and Fisht Stadium.

(continued on page 12)



The first Vine video sent from space by astronaut Reid Wiseman on June 6.



Images of current events, such as the Olympics and the World Cup, help NASA stay relevant and reach new and broad audiences while highlighting important messages such as international cooperation aboard the International Space Station.

2014: Year in review

As Johnson Space Center heads into deep space while maintaining a presence in low-Earth orbit, it's the people who have allowed the center to shine as bright as Sirius, the most brilliantly illuminated star in our nighttime sky. Read how the JSC family has influenced spaceflight past and present, benefited humanity and fostered collaboration.

Arc Jet facilities conduct last test run

From its opening in September 1963 until its closing earlier this year, Johnson Space Center's Arc Jet facilities were intended to be hands-on, enclosed fire-breathing labs where engineers gathered to recreate the extreme high-temperature air flows that spacecraft as different as Apollo and the space shuttle confronted to deliver their passengers safely back to Earth.

"We simply could not have carried out human spaceflight without the capability of the Arc Jet and the expertise of the people who have staffed it over the years," said JSC Director Ellen Ochoa. "Regardless of where the hardware is, we'll continue to need that expertise to address the safety of crews returning from space and other exploration activities."

A final JSC test run on March 21 was in support of a Safety and Mission Assurance internal research and development risk reduction project.



NASA PHOTO JAMES BLAIR

The Arc Jet team poses for a photo during the last test run in the facilities on March 21.

Methodist Institute for Technology, Innovation and Education (MITIE) to evaluate imaging of spaceflight hardware in MITIE's advanced imaging technology environment.

Using this local industry capability for NASA benefit stems from another cutting-edge collaboration, Pumps and Pipes, which every year brings three uniquely Houston industries (medical, energy and human aerospace) together to discuss shared challenges and explore each industry's toolbox for solutions. During a Pumps and Pipes planning dialogue, the topic of the emergency incident of water inside the EVA helmet during a spacewalk led to discussions about NASA's use of CT X-ray imaging for some of the EVA backpack components during the investigation afterward.

To explore this capability, a small team found an appropriate first test article and made the trip to Houston Methodist. With the help of scores of senior heart and imaging doctors and technicians, as well as more than a few wide-eyed onlookers, the collaboration successfully demonstrated the capability to image portions of an EVA suit. Plans for continued use of local advanced imaging capabilities are moving forward as JSC engineers and system leads begin to identify items and systems that could also benefit from state-of-the-art CT imaging.

Inventors unite for Wall of Fame unveiling

On May 16, the wall of the Building 11 Starport Café was adorned with a new fixture—an Inventors' Wall of Fame highlighting JSC's innumerable, talented innovators who, together, are responsible for the center's more than 160 patents.

NASA PHOTO LAUREN BETH HARNETT



From left, David Leestma and Arlene Andrews unveil the Inventors' Wall of Fame.

"This wall represents your creative minds and adventurous spirits that help shape the progress and success of human space exploration, and also bring space down to Earth with technologies to benefit mankind," said David Leestma, director of the Technology Transfer and Commercialization Office within the Strategic Partnerships Office. "The patents on this wall show a two-fold effect: they contribute directly to the business of NASA in human spaceflight, scientific development

and supporting the vision for exploration; and they're good for our public image. They show the public that NASA indeed has very smart people and that we continue to do some amazing things."

Spacesuit proves to be a model patient for a CT-imaging collaboration

Seasoned medical professionals did a double take this past summer when JSC personnel from the External Relations Office and Engineering took a non-flight Extravehicular Activity (EVA) spacesuit to the Houston

Destination Station campaign connects our orbiting laboratory with potential researchers, space supporters

With 15 years of established operations and national laboratory status, the International Space Station is a critical component to the future of research and technology development endeavors. Crew operations almost entirely focus on research and the associated Earth benefits that the space laboratory can provide to all humankind. With a core message of "Off the Earth, for the Earth," the Space Station Program is engaging the world with the science conducted on the station and, more specifically, with the importance of a zero-gravity environment for expanding experimental testing capabilities.

In 2014, Destination Station visited Los Angeles, Indianapolis and San Diego. During these visits, NASA personnel met with potential researchers in industry and academia, local legislative officials, media representatives, schools and the general public through various events. In a relatively short time, the campaign had a tremendous impact on each of the communities visited and successfully engaged the private sector to develop research project protocols that include the station as a testing platform.



NASA PHOTO

Astronaut Mike Hopkins participates in a Train Like an Astronaut event sponsored by the San Diego Chargers and NFL PLAY60 during Destination Station San Diego.

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2014 Social Media Highlights: The digital age is here



This “Epic selfies!” post on the International Space Station Facebook page reached more than 2.3 million fans.

Amazingly, the Olympic flame was in the images from space. This gave social media users a completely different and unexpected perspective.

During the World Cup, NASA highlighted international cooperation aboard the space station, especially between U.S. astronauts Steve Swanson and Wiseman and German astronaut Alexander Gerst during the United States versus Germany World Cup match. These calendar-driven, trending events give NASA the perfect opportunity to showcase the different parts of our mission. The World Cup also provided an opportunity to discuss research by highlighting

the technology behind the World Cup soccer ball and tell that story to an audience not ordinarily exposed to it.

The International Space Station Facebook, Twitter and Instagram pages are used to share images from the space station, highlight research being done in space that benefits us on Earth and share live coverage of dynamic mission events. In 2014, the space station Facebook page grew by more than 1 million fans, increasing to 1.3 million fans total. One post, proving that the “selfie” is not a thing of the past, shared “Epic selfies! From space no less!” This single post reached more than 2.3 million individual Facebook newsfeeds—more than twice the amount of fans of the page at the time of posting. People are intrigued by the work being done on our orbiting laboratory, and that story is being shared to thousands of people daily through social media.

This past year was also exciting for the Orion Program, hitting major milestones all leading up to the historic first flight test. Orion brought the whole world along for the #JourneyToMars by sharing events on Twitter, Flickr, Facebook and Instagram. The hype continued to build throughout the year, and the @NASA_Orion Twitter account surpassed 100,000 followers.

Orion also offered the public a unique opportunity to be a part of NASA’s Journey to Mars by allowing the public to submit their names to be flown on a microchip aboard Orion. More than 1 million people signed up, including celebrities such as Pharrell, Elmo, Dwight Howard, several astronauts and many others—who shared that experience with the world on social media, increasing the awareness and enthusiasm for Orion.

An epic video dubbed “Trial by Fire” was posted on the ReelNASA YouTube channel and was viewed more than 400,000 times within the first few days of posting. The video gives a captivating and understandable explanation of Orion and the first flight test.

Social media allows NASA to weave its own story, rather than relying on the media to tell it. Social media has given NASA the power to put a message, a video, an image or finding directly into the hands of the public. It is also an easy way for NASA to engage the public by answering questions and providing access to opportunities to talk with experts through live and virtual events. As the world goes digital, JSC’s social media accounts will continue to grow and become a crucial tool to help spread NASA missions and inspire others.

Visit <http://www.nasa.gov/connect> for more information and a complete listing of NASA’s social media accounts. Join in the chatter and the sharing!

